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The collaboration between Int J Life Cycle Assess and J LCA Jpn

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1 Preamble

The Institute of Life Cycle Assessment, Japan (ILCAJ) was established in October 2004. The goal of ILCAJ is to promote academic activities related to life cycle thinking and to share expert knowledge with colleagues from wider-ranging backgrounds. Professor Ryoichi Yamamoto, University of Tokyo, has taken responsibility as Chairman of ILCAJ.

In April 2005, ILCAJ has successfully established its publication organ (in Japanese), The Journal of Life Cycle Assessment, Japan (J LCA Jpn). The issues appear every 3 months. J LCA Jpn publishes peer-reviewed research articles, commentaries and discussions, (technical) reports, lecture notes, and presentations of research groups in Japan, along with others. In Int J Life Cycle Assess 12(6):348–350, we were happy to announce the collaboration with J LCA Jpn for the purpose of exchanging knowledge, new insights, experiences, and information across the different languages.

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The Corner JLCA Jpn aims to be a bridge between the LCA community of Japan and that of the whole world. All abstracts of research articles published in J LCA Jpn, as well as commentaries and discussions, will simultaneously appear in Int J Life Cycle Assess, Corner: JLCA Jpn, in order to introduce Japanese activities to our readers. In addition, some selected research papers from J LCA Jpn will be submitted to Int J Life Cycle Assess for publication following peer review. We hope that this collaboration will stimulate the global exchange of information through professional pathways. The following abstracts were published in J LCA Jpn Vol. 4, No. 4.

Professor Hiroshi Mizutani, Nihon University has become the Editor-in-Chief of our journal since January 2009.

2 Research article

1.1 Estimation of recoverable household waste cooking oil and life cycle analysis of biodiesel fuel production

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Objective. The project to produce BDF from waste cooking oil has started in some autonomous communities of Japan. In this study, the waste cooking oil potential was estimated by using data obtained by questionnaire survey and demonstration of collection from households. Furthermore, we apply life cycle analysis for accounting the environmental load of BDF production projects. The variation of environmental load was showed by each uncertain factor in this analysis and the way of decreasing environmental load was considered.

Result and discussion. Tahara city in Aichi prefecture was selected as the case study area. The recoverable waste cooking oil was estimated to be 2.4 kL/year in Tahara city. CO_2 emission and energy consumption were estimated in the life cycle of BDF production system. The result shows that environmental load by transport between household and collection point was the biggest factor in the life cycle when evaluated by using the default value. The condition of low environmental load was changed by the uncertain factors that are the distance between household and collection point and the amount of waste cooking oil from households. The result showed that if the collection frequency changes to every 2 months, CO_2 emission became lower than that from diesel and it can improve the net energy.

Conclusions. BDF production system was analyzed by applying life cycle analysis and we considered the conditional equations about CO_2 emission and net energy value. It was found that there is the situation of increasing environmental load by the project of BDF production from household waste cooking oil. It is important to consider the uncertain factors in the BDF project.

1.2 Life cycle assessment of domestic and transboundary recycling of post-consumer PET bottles

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Background and objective. In recent years, besides domestic recycling, a part of Japanese post-consumer PET bottles are exported to and recycled in mainland China. In this study, life cycle assessment was applied to the comparison of PET bottle recycling scenarios, including domestic recycling and transboundary recycling between Japan and China, from the viewpoint of CO_2 emission and fossil fuel consumption.

Results and discussion. The following ten scenarios based on our field surveys were evaluated: Japanese post-consumer PET bottles are (1) recycled into polyester staples in Japan, (2) recycled into polyester filaments in Japan, (3) recycled into polyester clothes in Japan, (4) chemically decomposed and recycled into bottle-grade PET resin in Japan, (5) chemically decomposed and recycled into polyester filaments in Japan, (6) and (7) recycled into polyester staples in two different flows in China, (8) recycled into polyester clothes in China, (9) incinerated and partly recovered as electricity in Japan, and (10) directly landfilled in Japan. The results showed that all the domestic and transboundary recycling scenarios had smaller impacts than the incineration scenario and that the chemical recycling scenarios had larger impacts than the other recycling scenarios. The robustness of the results was examined against the variability of background parameters for electricity supplies and against the specification of virgin products substituted by recycled products.

Conclusions. The differences of CO_2 emissions and fossil fuel consumptions between domestic and transboundary recycling scenarios, other than the chemical recycling scenarios, were not large enough to be robust against the above-mentioned variability. In particular, the variability strongly influenced the results of the scenarios including cloth-manufacturing processes in their system boundaries.

1.3 The technical considerations in the compilation method of interregional waste input–output table

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Objective. The present paper proposes a general compilation method of the interregional waste input–output table. As a case study of compilation, we estimated the interregional waste input–output table for Tokyo, which demonstrates the characteristics of waste emission and its treatment in Tokyo and other regions. We also indicate some critical issues and present some proposals about the modeling of industrial waste treatment and the treatment of illegally dumped waste in the interregional waste input–output analysis.

Results and discussion. The compilation method of the interregional waste input–output table consists of four steps, the estimation of the sectors of goods and services, the waste input and output sectors, the environmental loads sectors, and the waste treatment sectors. The amount of waste and interregional transportation amount can be estimated by using the statistical data of local governments and the Ministry of the Environment. The fourth step is the most important step. We present submodels to estimate the activity of waste treatment sectors by obtaining detailed information about waste treatment technologies from Tanaka and Matsuto et al. The formulation of submodels depends on the characteristic of regions. We show a practical method of estimation and models in the case

study of Tokyo. In the estimation of the interregional waste input–output table for Tokyo (TWIO), we assumed three types of submodels, which differ in the location and parameters of waste treatment facilities. The estimated TWIO table for 1995 demonstrates the characteristic of waste emission and its treatment in Tokyo and other regions. The sorts of waste in Tokyo are mainly composed of "organic sludge," "construction debris," "inorganic sludge," and "glass bottles and cullet." Over three million tons of waste, which account for 12%, emitted from Tokyo are transferred and treated in other regions. The tendency of the sorts of waste emission in Tokyo and in other regions is quite different. The sorts of waste in other regions are mainly composed of "animal waste," "incineration ash," "molten slag," and "inorganic sludge."

Conclusions. The reliability of the interregional waste input–output analysis depends on the reliability of the compilation of its table. The sufficient disclosure and the quality of the related statistical data are the critical issues for the reliable compilation of the interregional waste input–output table. Especially the corroborative information for the modeling of the industrial waste treatment is needed. The improvement of the submodels for interregional waste transportation is also needed. The stock analysis of illegally accumulated dumped waste will also be an important subject.

1.4 A study on relation between CO_2 emission and weight of machinery equipment by using input–output tables: for simplified estimation of CO_2 emissions

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Background and aim. CO_2 emission from the production process of energy equipment is often a trade-off for CO_2 emission in operation. A simplified method would be useful for estimating approximate CO_2 emission from a production process of energy equipment. On the other hand, the authors have been trying to evaluate energy systems and technology from the viewpoint of material use. We have used weight as a measure of material use, as it is relatively easy to get weight data for energy equipment. Therefore, if the weight of the energy equipment has a positive correlation with the CO_2 emission, the weight would be a good measure in a simplified estimation of CO_2 emission. From this point of view, in this paper, we discuss relations between weight of energy equipment and CO_2 emission from their production process by using input–output tables.

Results and discussion. In this paper, we use input–output tables (year 2000) as a common data source of weight of energy equipment and CO_2 emission. We chose 15 from 400 categories of input–output tables, most of which are energy equipment and industrial machines. Studies by the "National Institute for Environmental Studies" show that most of the CO_2 emission is from metals, e.g., iron and steel, and power supply. We, therefore, estimate the weight of the metals for 15 selected categories. We calculate the weight from the weight of intermediate categories that was calculated from the weight of the metals by using material tables. The resultant relation between weight and CO_2 emission from production process is approximated as follows: $c=1.99m+1.50p$ where c is the CO_2 emission (in tons), m is the material weight of the product (in tons), and p is the producer price of the equipment (million yen) The weight coefficient 1.99 is approximately equal to the CO_2 emission per unit weight of pig iron, 1.50, implying that most of the CO_2 emission is from metals, e.g., iron and steel. The price coefficient 1.50 corresponds to CO_2 emissions from electric power for production process and energy for transportation, etc.

Conclusions. A simple approximate relation between CO_2 emission from production process and total weight of energy equipment has been derived. This approximate method is useful to evaluate CO_2 emission from production processes, when only limited information about equipment, e.g., the equipment weight, is available.

1.5 An estimation of embodied intensity of water consumption in Japan based on input–output analysis method

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Objective. Water consumption is one of the environmental performance indicators and should be managed as a significant environmental aspect of business. Recently, huge water consumption outside Japan corresponding to the productions of imported goods, known as "virtual water," is considered to be a serious environmental issue. The objective of this study is to estimate the total water consumption of Japan, including the indirect water consumption in upstream processes of the supply chain.

Results and discussion. Annual water consumption in Japan was estimated based on various statistics and allocated to the input–output table of Japan. Applying the input–output analysis method, embodied intensities of water consumption in Japan have been estimated. In order to clarify the data quality, they have been compared with results estimated by the process analysis method, focusing on grains, livestock, and meat. In the case of differences in embodied intensities of water consumption, parameters of their estimation processes are discussed. In addition, total water consumption of the Toshiba Group, which includes direct and indirect consumption, was calculated by using the embodied intensities estimated in this study. As a result,

it was found that total water consumption was about 0.167 billion tons and indirect consumption was about 2.6 times larger than direct consumption.

Conclusion. In this study, embodied intensities of water consumption in Japan were estimated based on the latest input–output table of Japan. They were compared with results based on process analysis. A case study was also presented in which total water consumption of Toshiba Group was calculated. In future work, we intend to apply life cycle impact assessment methods and, in order to make the embodied intensities of water consumption more useful for environmental management, improve the data quality.

1.6 On the ecological effect of changing in our consumption behavior: a simulation analysis using the demand function in the semi-flexible AIDS and the environmental input–output table

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Objective. The objective of this study is to investigate how to reduce the environmental load induced by consumers with ones' minimum endurance, in other words, with a minimum reduction of utility. To carry this out, we firstly combined the environmental household accounting based on our input–output analysis with the demand function in the semi-flexible AIDS. Then, we specified on the consumers' lifestyle changes as subjective discount behaviors. We focused on the following changes: the high use of eating out and recreation services and the changes in the means of transportation which result from new traffic policies: the road pricing system and mobility management.

Results and discussion. The increase in demand for eating out and using recreation services will increase both the utility level and the total amount of environmental load. But in the case when the eating out demands change, the environmental efficiency of the consumption behavior decrease, while it increases along with the changes in recreation demands. The two types of changes in transportation means will increase the utility level and the utility per environmental load. The total amount of environmental load, however, will decrease by introducing the road pricing system, whereas it increases by way of the mobility management.

Conclusions. It is clear that reduction of the environmental load induced by consumers' minimum endurance is very difficult. But some results in our simulation analysis show that some changes in our lifestyles improve the environmental situation as well as the utility level. We should seek such changes of lifestyles and in the device of consumption.

1.7 Global warming impact associated with a personal computer on the Internet

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Objective. A life cycle assessment (LCA) of a personal computer (PC) connected to the Internet is required because of the concern that environmental load will increase by worldwide growing Internet population. This study was performed as a case study to evaluate the life cycle global warming impact of a PC under Internet condition by LCA (with process analysis method).

Results and discussion. The subject PC system was composed of a desktop PC coupled with a 15-in. liquid crystal display (LCD) and a router. During this study, several key data were obtained such as the foreground data of LSI manufacturing stage, the amount of power consumption of PC during use stage, and some components like CD-ROM, hard disk, keyboard, and so on. By this study, it became clear that LSI emitted several hundred times amount of greenhouse gas (GHG) of its own weight during the production stage, and also that the global warming impact by electrical parts was much higher than materials such as iron and resins. On the other hand, this study revealed the deficiency of the background data of electrical parts like the resistor, transformer, connector, circuit board, and so on.

Conclusion. The foreground data of LSI and the data of the components of the PC obtained in this study may be very useful for the analyses of many other electric devices. However, the deficiency of the background data of many electric parts was revealed. The background data of the electric parts should be collected more and more.